EMCal for eID: Shower Profile

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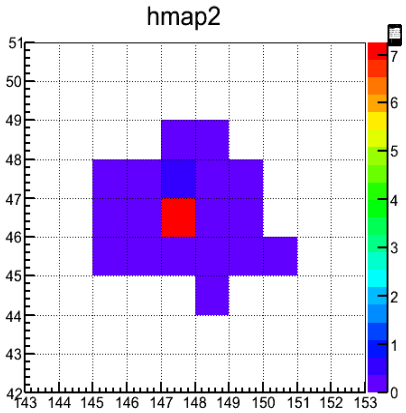
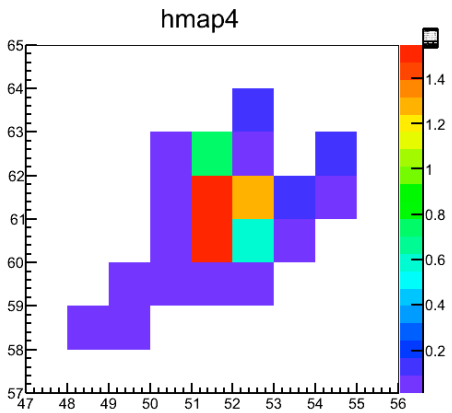
Evaluating shower profile

Electron

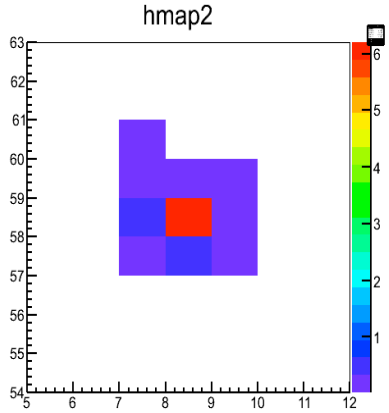


Well defined shower shape

π-



Broader shape



Very similar to electron shower shape

$$\chi^2 = \sum \frac{(E_i^{meas} - E_i^{pred})^2}{\sigma_i^2}$$

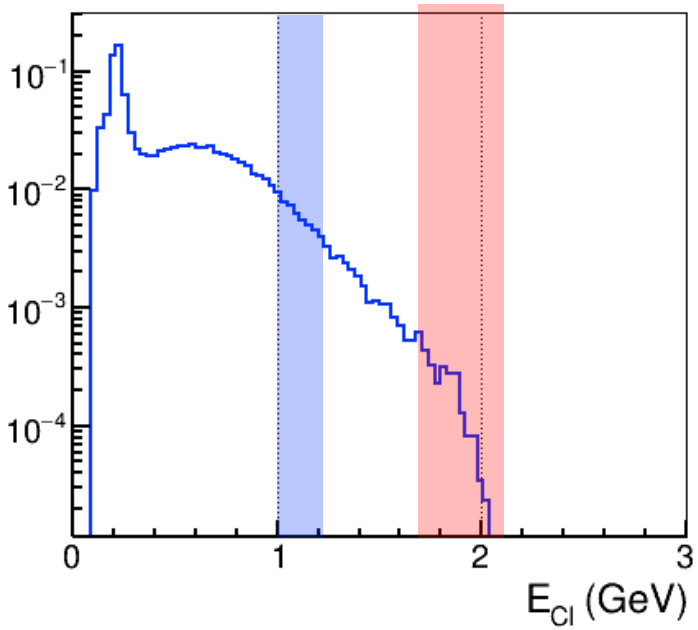
E_i^{meas} – measured energy in a tower

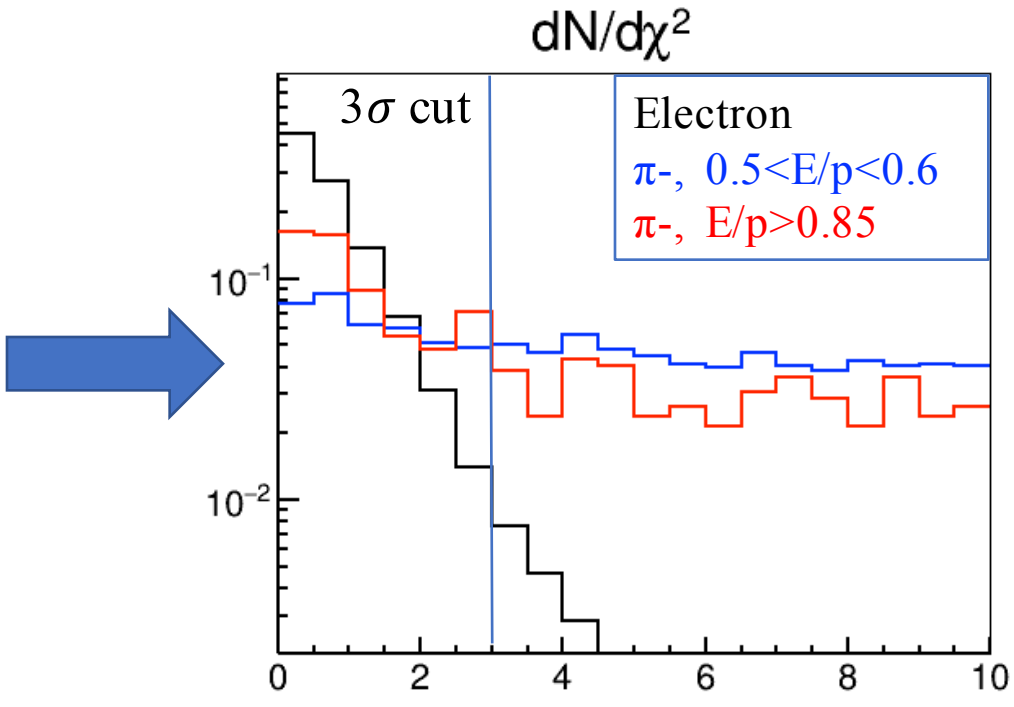
$E_i^{pred} = E(x_i\text{-}x_{CG},\ y_i\text{-}y_{CG})$ – predicted energy in a tower from electron shower parameterization

$\sigma_i = \sigma(x_i\text{-}x_{CG},\ y_i\text{-}y_{CG})$ – fluctuations in a tower from electron shower parameterization

Profile χ^2 : electron vs π-

EMCal response to 2 GeV/c π-

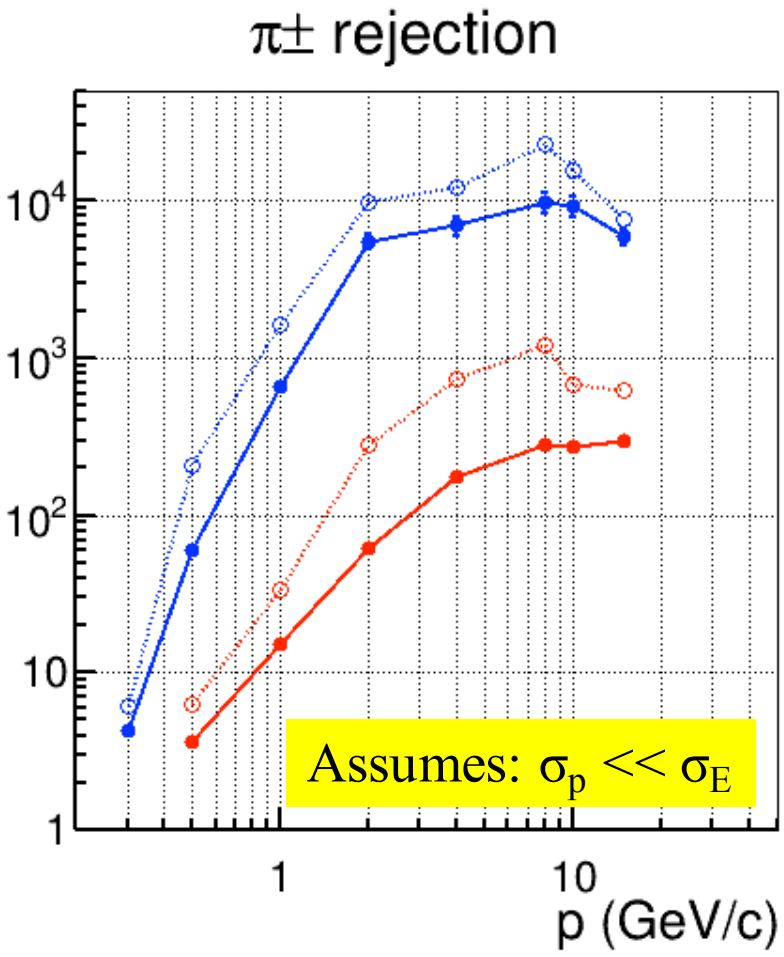




Rejection ~10

Rejection ~4

π± rejection: E/p and profile



Solid: E/p, ε_e=95%
Dashed: E/p+Prof, ε_e=92%

Ideal case:
- No material on the way to EMCal
- Perfect EMCal (no gaps/cracks)
- Gaussian response to electron

	$PbWO_4$ Crystal (GEANT)	W/SciFi (sPHENIX, GEANT)	PbSc (PHENIX, data)
Depth, X_0	20	~20	18
$\frac{\sigma_E}{E}$	$\frac{2.5\%}{\sqrt{E}} \oplus 1\%$	$\frac{13\%}{\sqrt{E}} \oplus 3\%$	$\frac{8\%}{\sqrt{E}} \oplus 2\%$
Depth, λ_I	0.87	~0.83	0.85
e/h	>2		<1.3

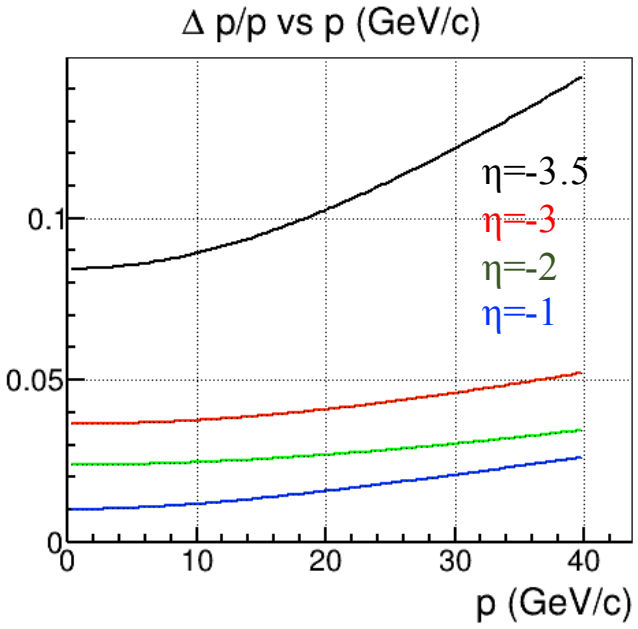
After E/p cut expect additional rejection by a factor of 2 (3-4) in PbWO4 (W/SciFi)

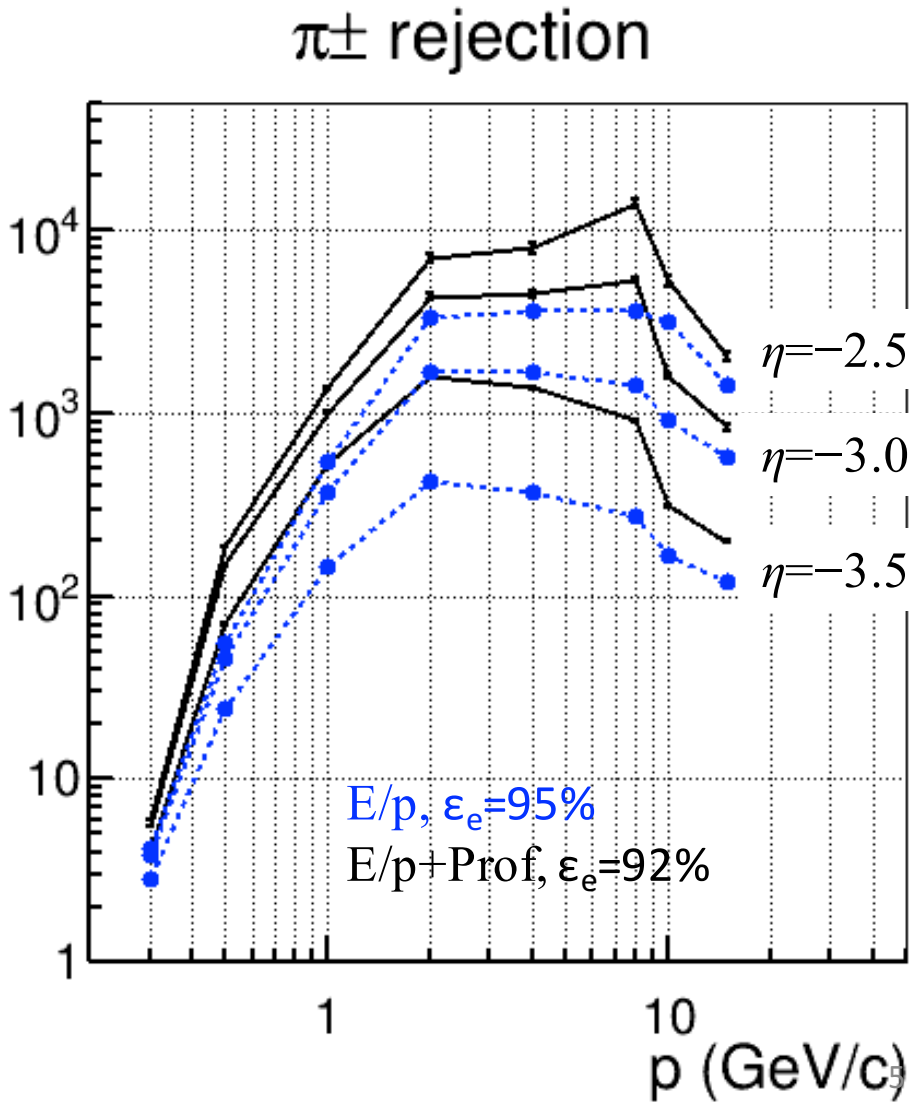
Including momentum resolution

$PbWO_4$ Crystal (GEANT)

$$\frac{\sigma_E}{E} = \frac{2.5\%}{\sqrt{E}} \oplus 1\%$$

BaBar-based Tracking model:
TPC (barrel), Si +GEM (forw)
(Fun4All-GEANT4 simulation)





DIS: Hadronic Background Suppression

$PbWO_4$ Crystal (GEANT)

$$\frac{\sigma_E}{E} = \frac{2.5\%}{\sqrt{E}} \oplus 1\%$$

BaBar-based Tracking model:
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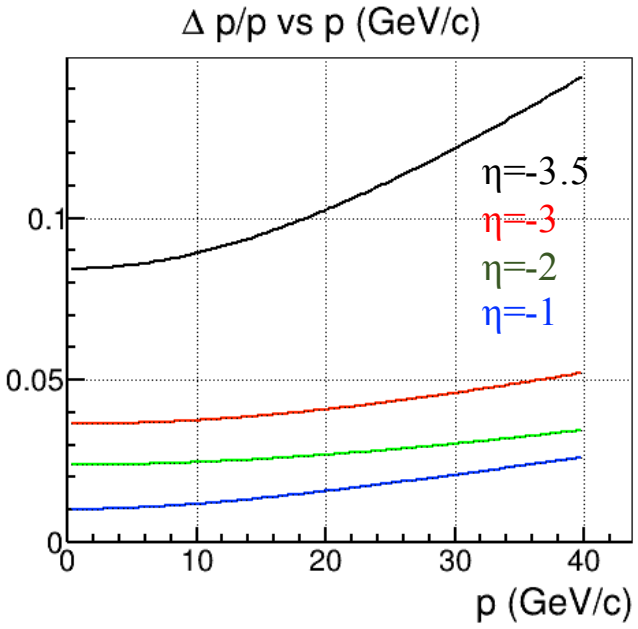
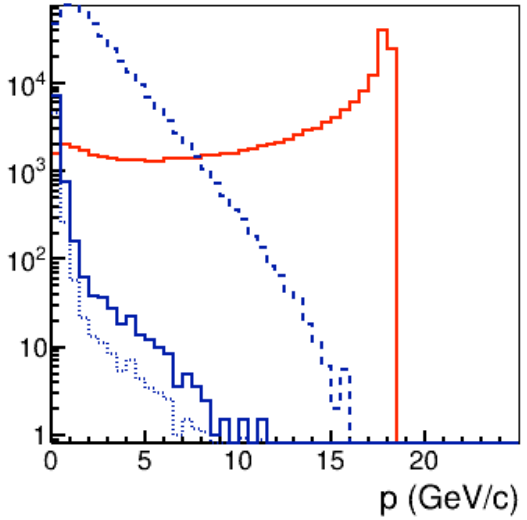
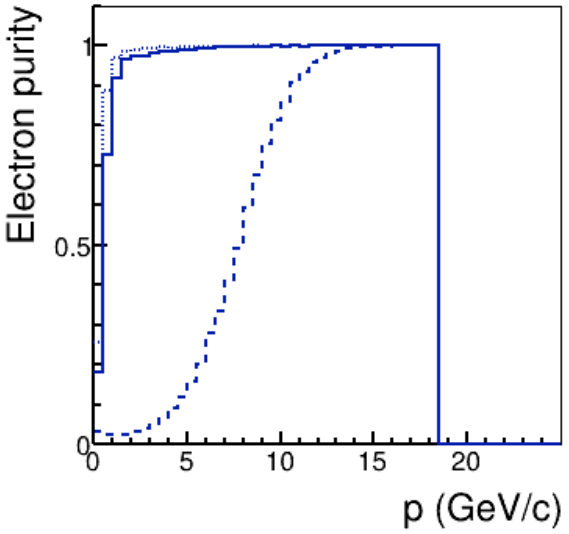


e+p 18x275
-3.5<η<-2



e
Dashed: π-
solid: π-, after E/p
Dotted: π-, after E/p+Prof

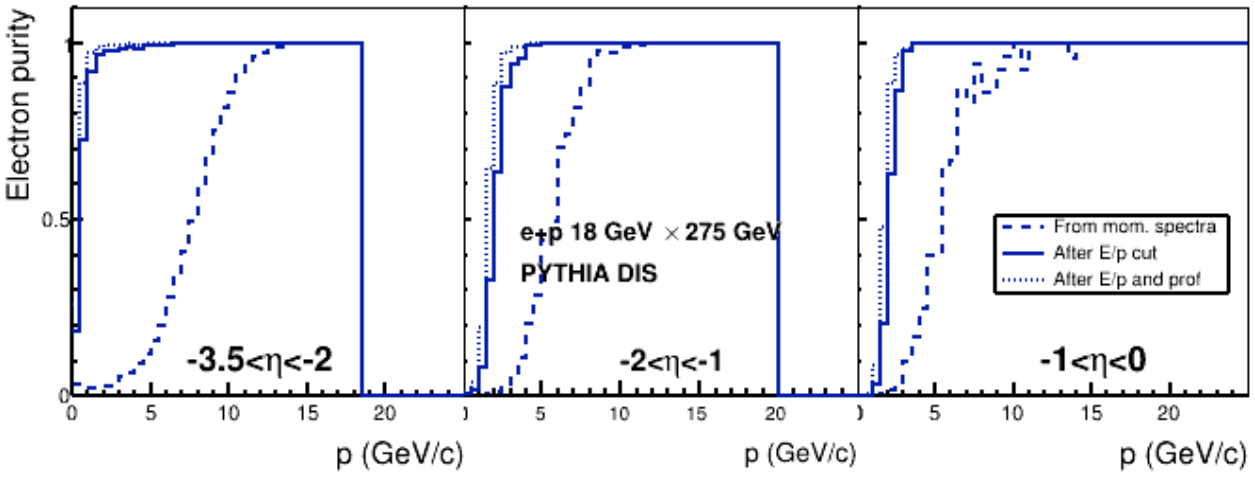


Purity = e / (e+π)

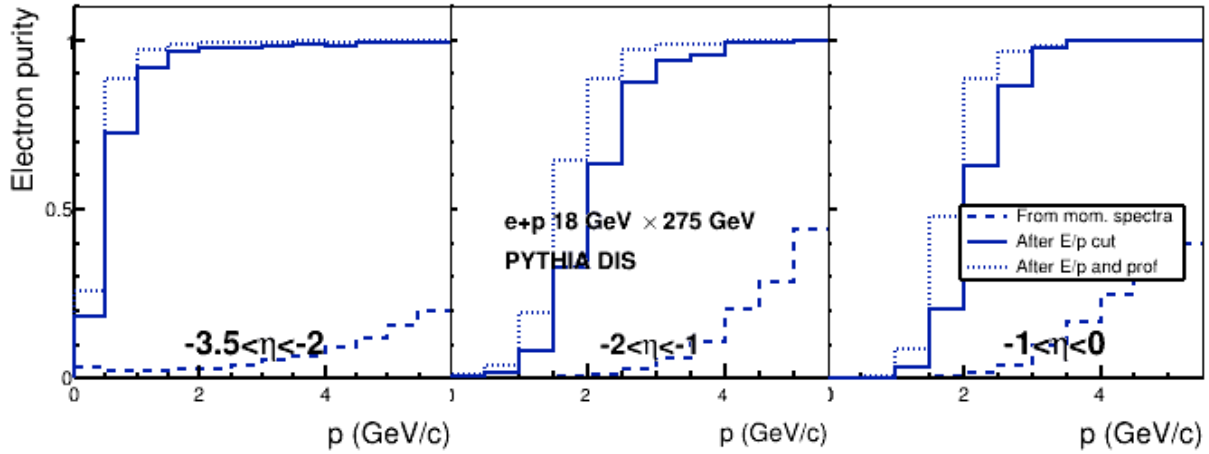
Dashed: Before eID
Solid: After E/p
Dotted: After E/p+Prof

DIS scattered electron purity

-3.5<η<-2	-2<η<-1	-1<η<1
$\frac{\sigma_E}{E} = \frac{2.5\%}{\sqrt{E}} \oplus 1\%$	$\frac{\sigma_E}{E} = \frac{7\%}{\sqrt{E}} \oplus 2\%$	$\frac{\sigma_E}{E} = \frac{12\%}{\sqrt{E}} \oplus 2\%$



Just zoomed



Ideal case:

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- Gaussian response to electron

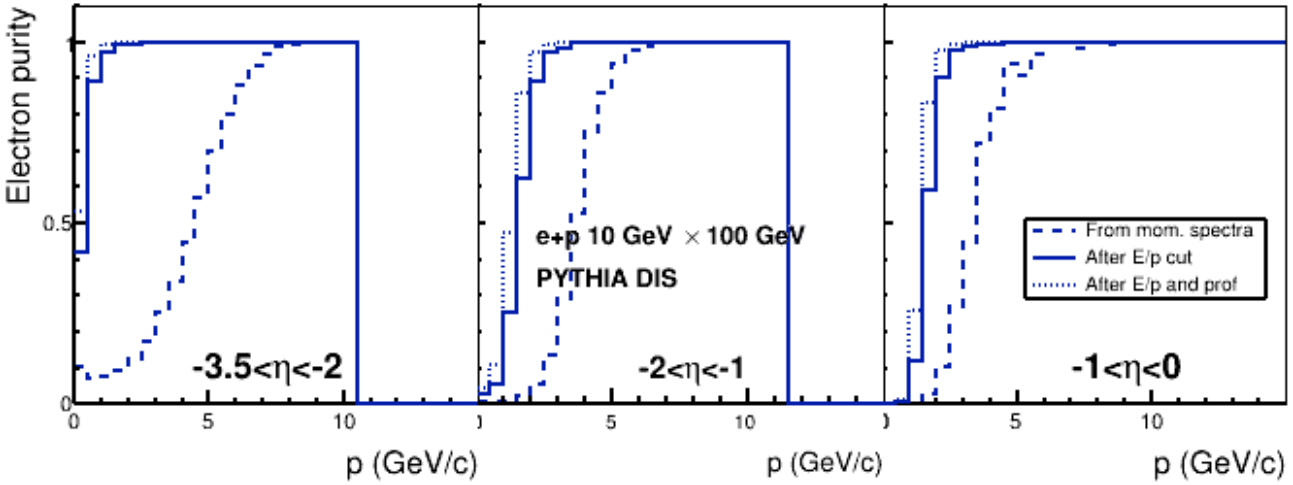
Purity = e / (e+h)

18 GeV × 275 GeV:

Clean eID at >2.5 GeV/c (purity > 96%)

DIS scattered electron purity

-3.5<η<-2	-2<η<-1	-1<η<1
$\frac{\sigma_E}{E} = \frac{2.5\%}{\sqrt{E}} \oplus 1\%$	$\frac{\sigma_E}{E} = \frac{7\%}{\sqrt{E}} \oplus 2\%$	$\frac{\sigma_E}{E} = \frac{12\%}{\sqrt{E}} \oplus 2\%$



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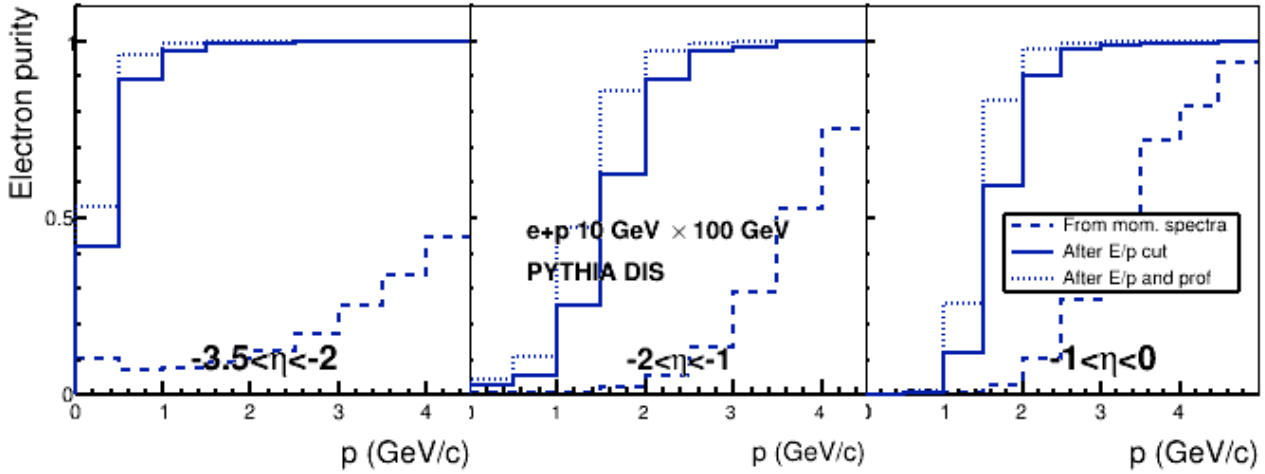

Ideal case:

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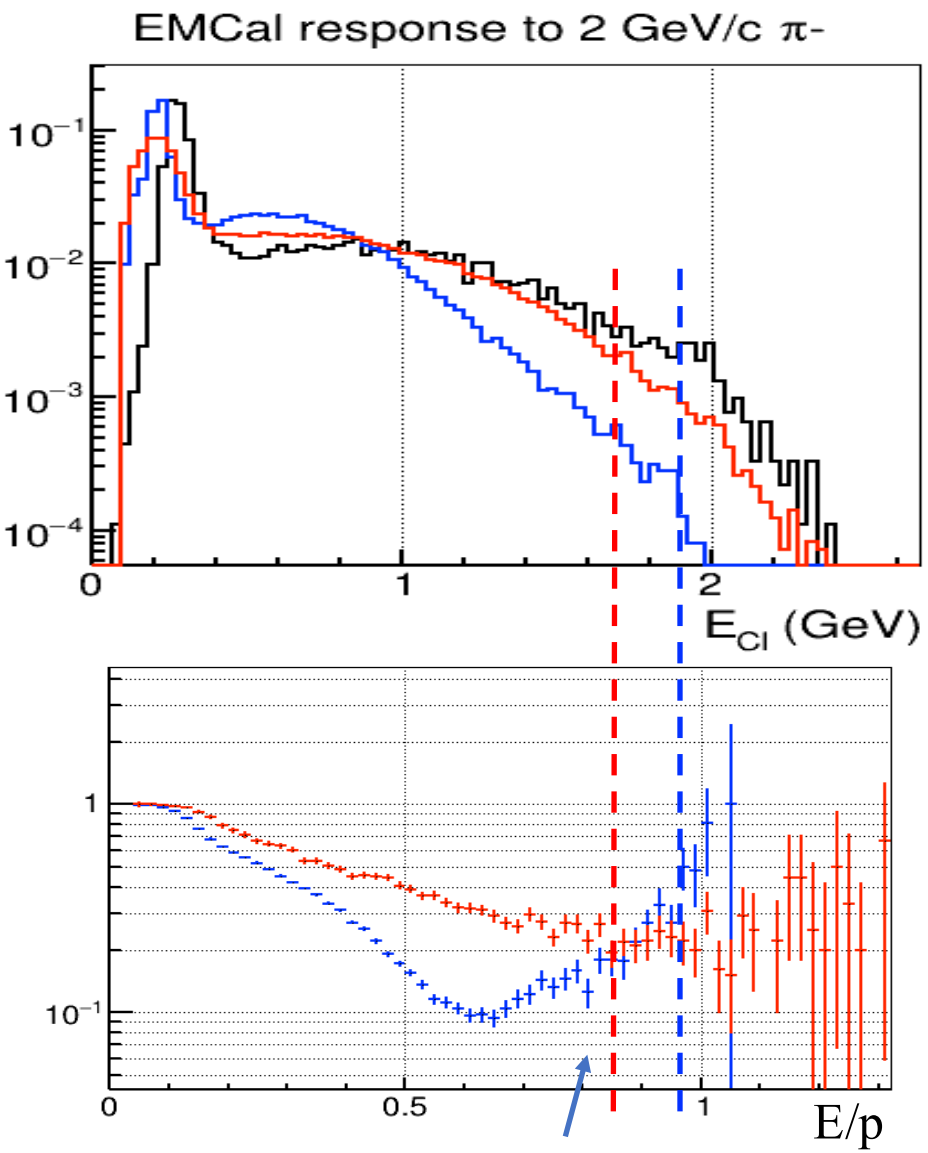
Purity = e / (e+h)

10 GeV × 100 GeV:

Clean eID at >2GeV/c (purity > 96%)

Backup

Profile χ^2 vs E/p



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After E/p cut expect additional rejection by factor of 2 (4) in PbWO4 (W/SciFi)

E/p > 1 - 1.6 · σ_{EMC} to keep ε_e=95%